4142001

F A long straight wire carries a current of 0.3 A.

(a) Find the magnitude of the magnetic field at a perpendicular distance 4 cm away from the wire. (2 marks)

(b) Part of the wire is in a uniform magnetic field of 4×10^{-4} T. The part of the wire is of 8 cm and makes an angle 50° with the magnetic field. Find the magnitude of the magnetic force acting on the part of the wire. (2 marks)

4142002

F E A proton moves in a uniform magnetic field of 3 mT at 25°. The magnetic force acting on it is 8×10^{-17} N. Find

(a) the speed of the proton, (2 marks)

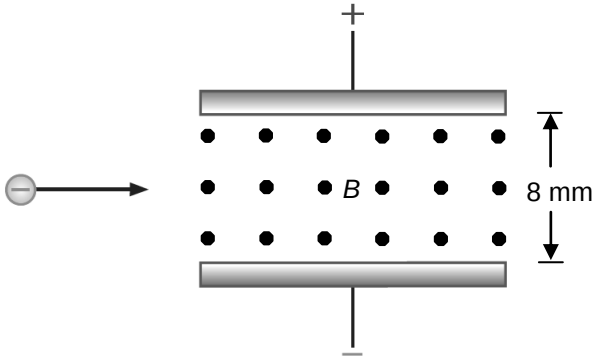
(b) the kinetic energy of the proton. (2 marks)

(Given the mass of a proton = 1.7×10^{-27} kg,

the charge of a proton = 1.6×10^{-19} C)

4142003

F E A uniform magnetic field is applied between two parallel metal plates separated by 8 mm. An electron enters the magnetic field as shown below. A voltage of 170 V is applied across the plates so that the electron keeps moving horizontally.

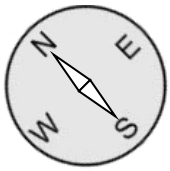


(a) Find the magnitude of the electric force acting on the electron when it is moving between the plates. (3 marks)

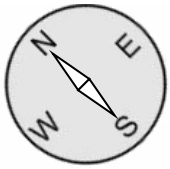
(b) The electron enters the magnetic field at a speed of 7.3×10^{7} m s^{-1}. Find the magnitude of the magnetic field. (2 marks)

4142004

Two compasses, *A* and *B*, are placed on a table at some distance away from each other as shown below.



compass *A*



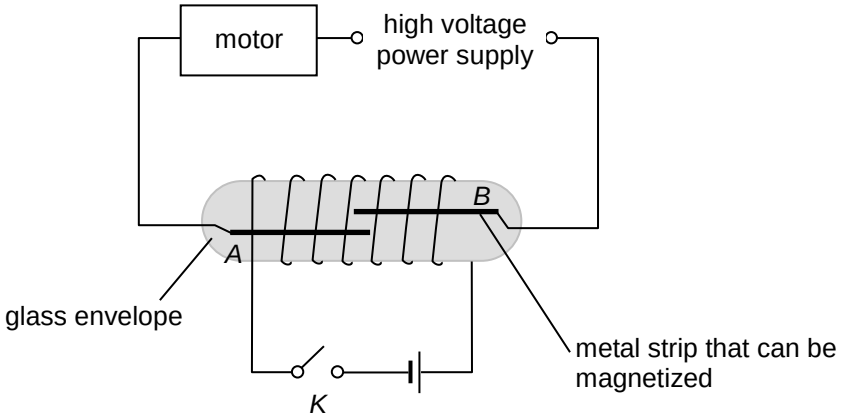
compass *B*

(a) If the two compasses are very close to each other, they may not indicate the North Pole of the earth correctly. Explain briefly. (3 marks)

(b) If one of the compasses is placed very close to a current-carrying cable, it may not indicate the North Pole of the earth correctly. Explain briefly. (1 mark)

4142005

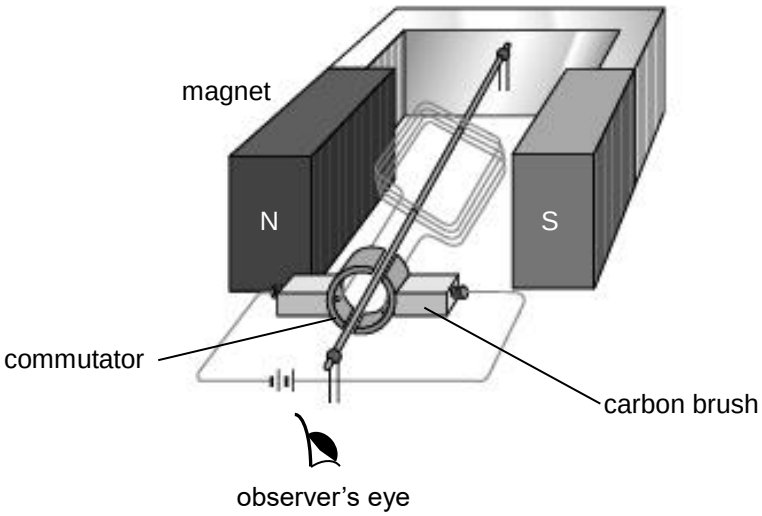
The following figure shows a simplified circuit for turning on a motor.



(a) When key *K* is closed, what happens to the metal strips *A* and *B*? Explain your answer. (4 marks)

(b) Does the motor operate when key *K* is closed? (1 mark)

6 The following figure shows the structure of a simple d.c. motor.



(a) To the observer, in which direction does the coil rotate, clockwise or anticlockwise? (1 mark)

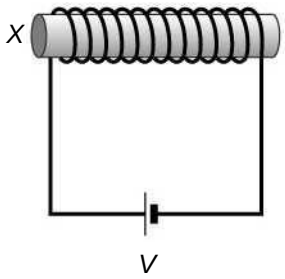
(b) Explain

(i) the function of the commutator, and (3 marks)

(ii) the reason why the coil rotates even at the moment when no current passes through it (i.e. when the commutator and the carbon brushes are not in contact). (1 mark)

4142007

The following figure shows a simple electromagnet.



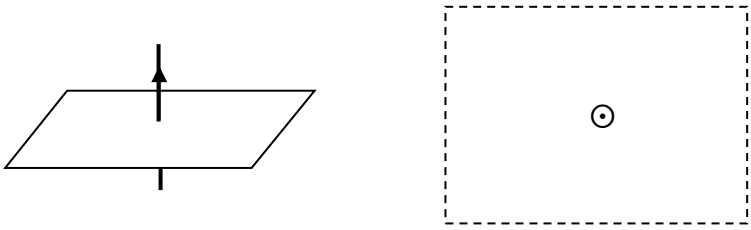
(a) What material is suitable to use as the core? (1 mark)

(b) Which pole is *X*? (1 mark)

(c) What two changes could be made to give a stronger magnetic field? (2 marks)

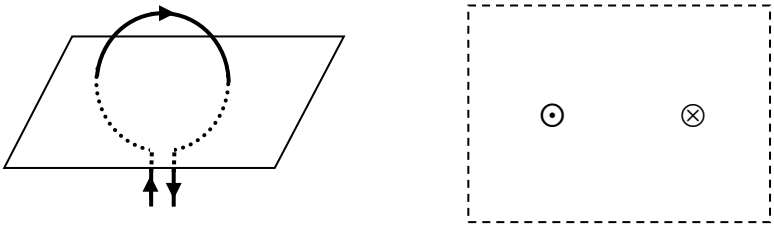
8 Sketch the magnetic fields formed on the planes around the following current-carrying wire.

(a)



(2 marks)

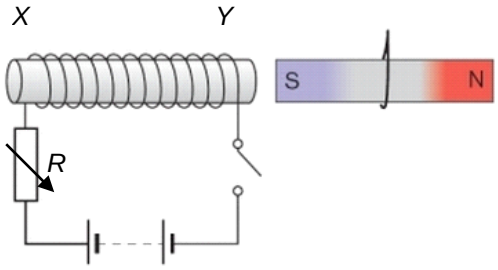
(b)



(2 marks)

4142009

A bar magnet is hung near an electromagnet, as shown below. The core of the solenoid is made of soft iron.



The electromagnet is now turned on.

(a) What is the direction of the magnetic field inside the solenoid, towards *X* or towards *Y*? (1 mark)

(b) Which end is the south pole, *X* or *Y*? (1 mark)

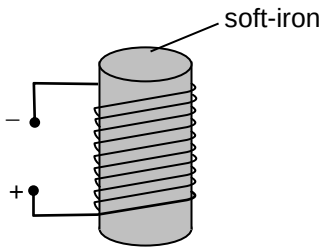
(c) Does the solenoid attract or repel the magnet? (1 mark)

(d) What happens if the resistance of rheostat *R* is increased? (1 mark)

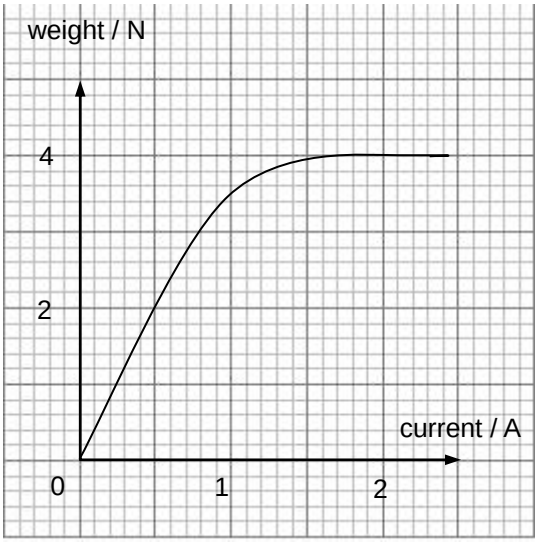
(e) What happens if the core of the solenoid is made of copper, instead of soft iron? (1 mark)

10

A student has constructed an electromagnet to pick up objects with different weight..



The following graph shows how the maximum weight picked up by the electromagnet depends on the current in the coil.



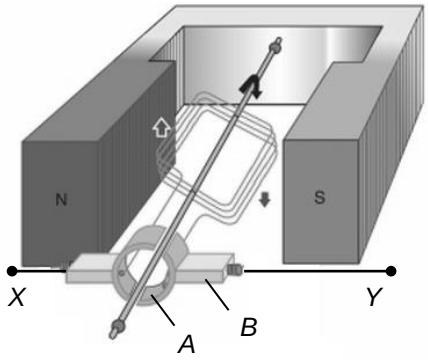
(a) What is the maximum weight that the electromagnet can pick? (1 mark)

(b) Suppose a current of I_0 is needed for the electromagnet to pick up a weight of 1.5 N. If the current is doubled, can the electromagnet pick up a weight of 3 N? Use the data from the graph to justify your answer. (3 marks)

(c) Suggest two ways to increase the maximum weight that the electromagnet can pick. (2 marks)

11

The following figure shows a simple d.c. motor.



(a) Terminals *X* and *Y* are connected to a battery. Which one is connected to the positive terminal of the battery? (1 mark)

(b) Name part *A* and describe its function briefly. (3 marks)

(c) Part *B* is made of carbon. Name part *B* and describe its function. (2 marks)

4142012

★

F Two long solenoids, *X* and *Y*, have lengths of 80 cm and 120 cm respectively. Both of them carry the same current. The magnitude of the magnetic field at the centre of each solenoid is the same. It is known that *X* has 6000 turns of wires.

(a) How many turns does *Y* have? (2 marks)

(b) By connecting *X* and *Y* end-to-end to form a new solenoid, will the magnetic field at the centre be larger? Explain briefly. (2 marks)

13★

F E An electron is moving into a uniform magnetic field of 8 mT at 7.2×10^6 m s^{-1}. The direction of the magnetic field can be varied.

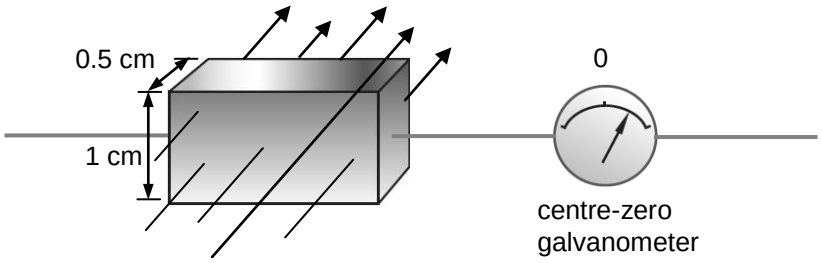
(a) State the conditions when the magnetic force acting on the electron attains maximum and minimum. In each case, find the magnitude of the magnetic force. (5 marks)

(b) If the acceleration of the electron is 9×10^{15} m s^{-2} at a certain position, what is the angle between the magnetic field and the moving direction of the electron? (2 marks)

(Given the mass of an electron = 9.1×10^{-31} kg,
the charge of an electron = -1.6×10^{-19} C)

14 ★ (out of syllabus)

F E The figure below shows a metal block and a galvanometer used in an experiment on Hall effect.



The metal block is placed in a uniform magnetic field of 2 T. The galvanometer deflects to the right and gives a reading of 3 A. A Hall voltage of 1×10^{-6} V is measured.

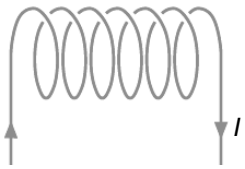
(a) Find the drift velocity of the charge carriers inside the metal block. (2 marks)

(b) Find the number of charge carriers per unit volume. (2 marks)

(c) If the sign of the charge carriers in the metal block is negative, in which direction are the charge carriers deflected under the magnetic field? (2 marks)

(Given the charge of each charge carrier = 1.6×10^{-19} C)

15 ★ The figure below shows a current flowing through a solenoid.



(a) In the figure, sketch the magnetic field pattern around the solenoid. (2 marks)

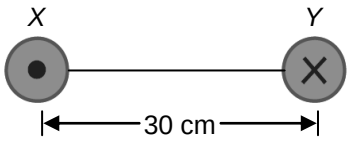
(b) Suggest two ways to increase the magnetic field due to the solenoid. (2 marks)

(c) An electromagnet is usually produced by wounding a coil of wire around a soft-iron core. What kind of property should the core have? (1 mark)

18

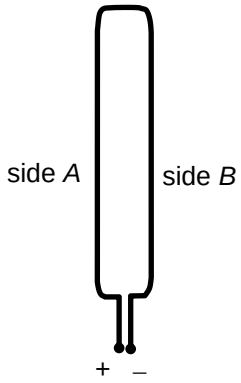
★

F Two long straight parallel wires *X* and *Y* are separated by 30 cm. The currents through wire *X* and *Y* are 5 A and 10 A respectively and flow in opposite directions. Determine the position at which the magnetic field is zero on the line shown below. Show your steps clearly. (3 marks)



4142022

★ A coil of resistance wire is shown in the following figure.



(a) Mark the current direction on the figure. (1 mark)

(b) What is the direction of the magnetic field produced by side *A* at the position of side *B*? (1 mark)

(c) Hence, determine the direction of the magnetic force acting on side *B*. Which rule do you use to determine the direction? (2 marks)

(d) Side *A* also experiences a force. Compare the forces experienced by sides *A* and *B*. (2 marks)

4142023

★ A student has constructed an electromagnet in Figure a.

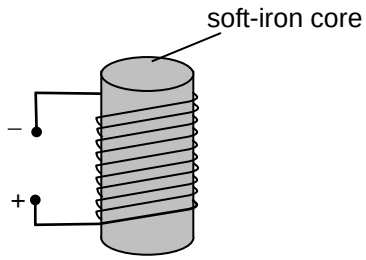


Fig a

He uses this electromagnet to lift up some paper-clips. He finds that a larger current is needed to attract more paper-clips. Figure b shows the relationship between the current and the number of paper-clips that can be attracted.

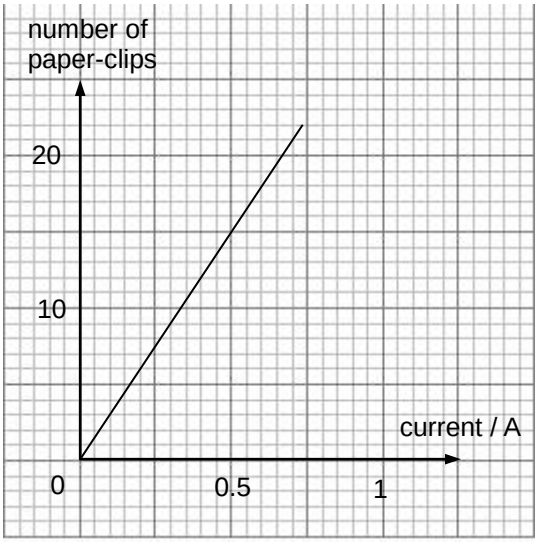


Fig b

(a) If each paper-clip weighs 1 g, what is the mass that the electromagnet can lift when the current is 0.1 A? (2 marks)

(b) The student modifies the electromagnet as follows:

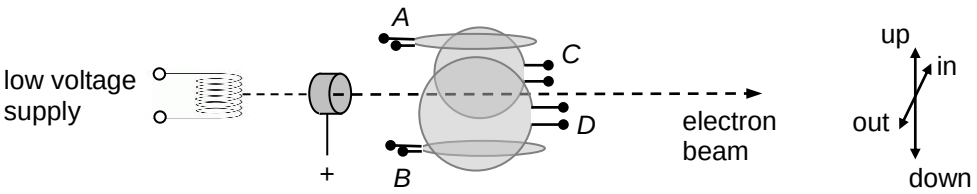
(i) Increase the size of the coil, together with the soft-iron core, of the electromagnet.

(ii) Increase the number of turns of the electromagnet.

Sketch on the graph the results for each of the modification. (2 marks)

4142024

★ In the following figure, the low voltage supply heats up the coil and produces a stream of electrons. Coils *A* and *B* are horizontal while coils *C* and *D* are vertical. The coils are used to deflect electrons. When no voltage is applied across the coils, electrons travel forwards without deflection.



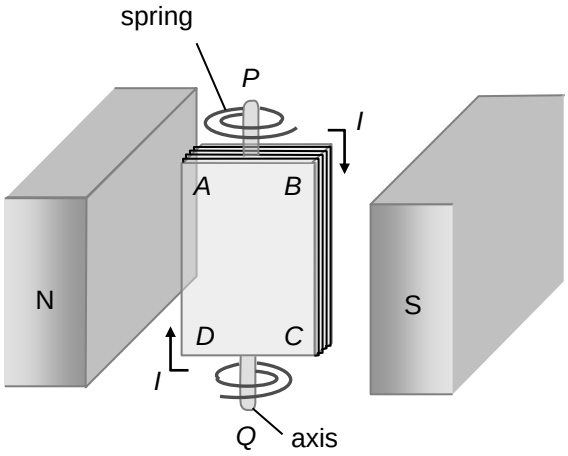
(a) Which set of coils deflects electron beam upwards and downwards? (1 mark)

(b) Mark on the figure '+' and '–' to show the terminals of the coils if the electron beam is deflected upwards and towards coil *C*. (2 marks)

(c) It is known that when electron beam hits fluorescent screen, a light spot is

4142025

★ In the following figure, a coil is put between the poles of a magnet.



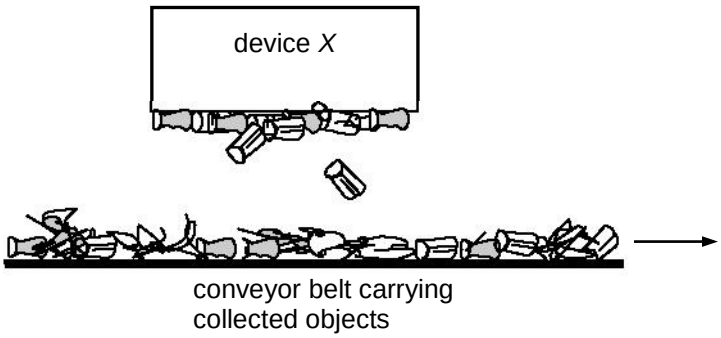
(a) Mark on the figure the directions of the magnetic forces acting on the sides *AD* and *BC* at the moment shown. Hence, find out the direction in which the coil turns as viewed from top at *P*. (3 marks)

(b) Is there any magnetic force acting on the sides *AB* and *CD* when the coil starts to turn? Do these forces affect the rotation of the coil? (3 marks)

(c) The springs at the top and at the bottom of the coil provide a force to stop the coil from turning. How can this setup be used to determine the size of current through the coil? (1 mark)

4142026

★ The following figure shows a device *X* in an aluminium recycling plant. Device *X* can remove iron objects from other collected objects and it dumps the iron objects to another place.



(a) What is device *X*? Explain briefly why it is used in the plant. (4 marks)

(b) Sketch a simple diagram for device *X*. (2 marks)

(c) Suggest two methods to improve the device in (a) so that it can remove more iron objects. (2 marks)

{{<P=41><C=04><S=core><T=SQ><M=7><L=2><X=H><id=027>}}

4142028

★ Figure a shows a coil connected to a cell and a magnet is attached to the cell. The coil is made of naked conducting wire.

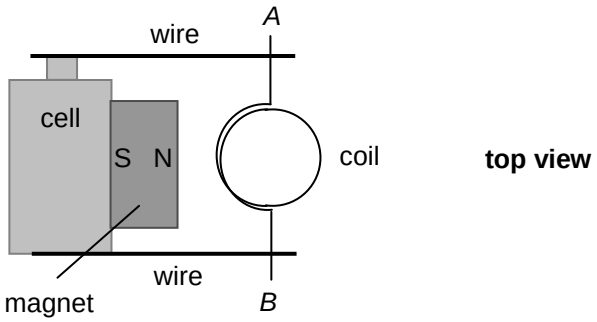


Fig a

(a) Mark on the figure the terminals of the cell and the direction of the current flowing through the coil. (2 marks)

(b) Describe briefly the motion of the coil. (2 marks)

(c) The coil is now replaced by an insulated coil with insulation at the ends *A* and *B* removed as follows:

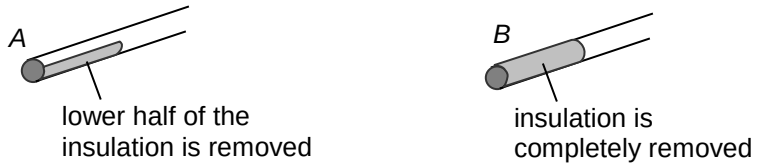
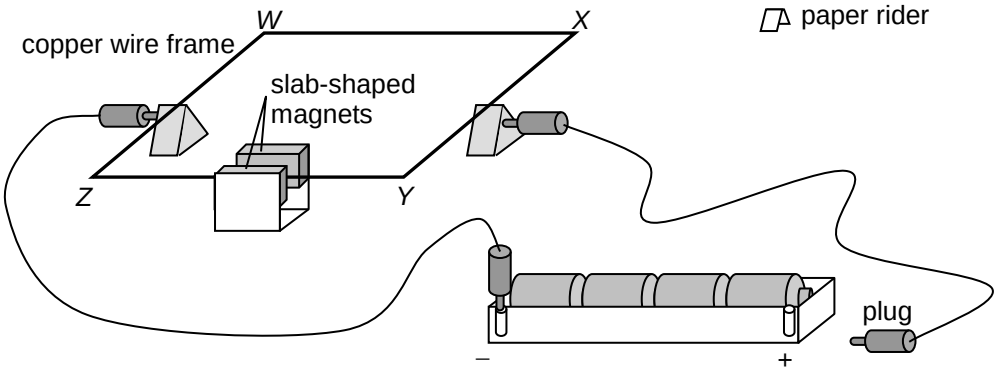


Fig b

Can the coil rotate smoothly? Explain briefly. (3 marks)

4142029

★ In the following figure, a copper wire frame *WXYZ* is balanced by two triangular supports. All of its sides are horizontal. Part of the side *YZ* is put inside a uniform magnetic field of two slab-shaped magnets.



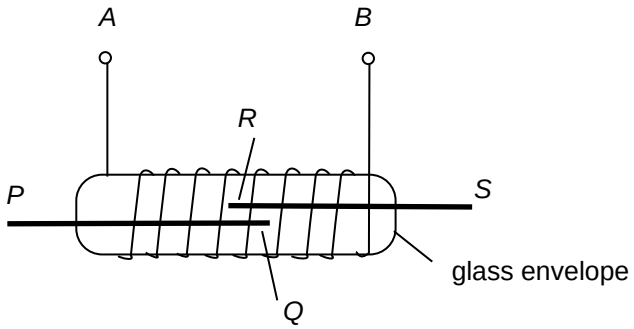
A paper rider is dropped over the side *WX* of the wire frame.

(a) How does the side *YZ* move? (1 mark)

(b) The wire frame is balanced again when it is connected to the battery. Draw a top-view diagram to show the direction of the current through the copper wire frame *WXYZ* and the magnetic field formed by the two slab-shaped magnets. (3 marks)

4142030

★ The following figure shows a device that consists of two thin soft-iron strips *PQ* and *RS*, partly enclosed in a glass envelope. A solenoid is wound around the glass envelop.



(a) The soft-iron strips are magnetized when a current passes though the solenoid. If the current flows from *A* to *B*, what are the polarities of the ends *P*, *Q*, *R* and *S*? (2 marks)

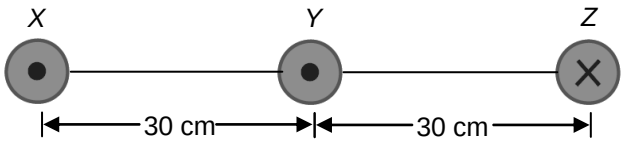
(b) Terminals *A* and *B* are connected to a switch circuit. If the switch is closed, will the contact *QR* be closed or open? (1 mark)

(c) The device is often used to switch on/off a large current circuit connected to terminals *P* and *S* indirectly. What is the advantage of using the device to control a large current circuit? (2 marks)

4142031

★★

F The figure below shows three long straight parallel wires *X*, *Y* and *Z*. *Y* carries a current of 12 A. The resultant magnetic force acting on *X* is zero while the magnetic force per unit length acting on *X* due to *Y* is 4.2×10^{-4} N.



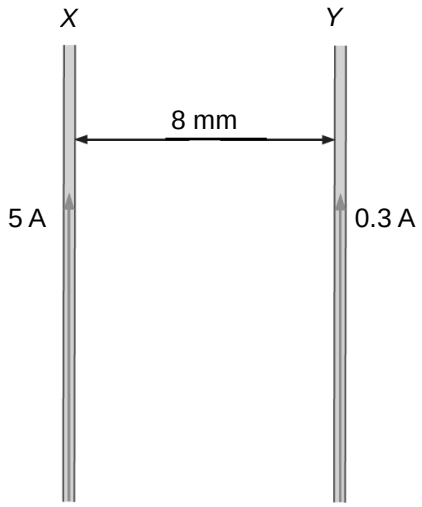
(a) Find the current in *X* and *Z* respectively. (4 marks)

(b) Hence find the resultant magnetic force per unit length acting on *Y*. (2 marks)

4142032

★★

F Two long straight parallel wires *X* and *Y*, carrying currents of 5 A and 0.3 A in the same direction respectively, are separated by a distance of 8 mm.

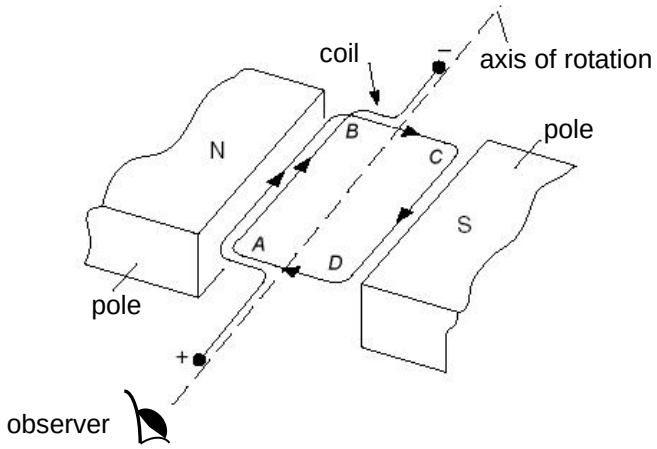


(a) Find the magnetic force per unit length acting on the two wires. (4 marks)

(b) If the direction of current in *Y* reverses, how will the magnetic force acting on the two wires change? (2 marks)

4142034

★★ In the following figure, a coil connected to a cell is placed between the poles of two magnets.



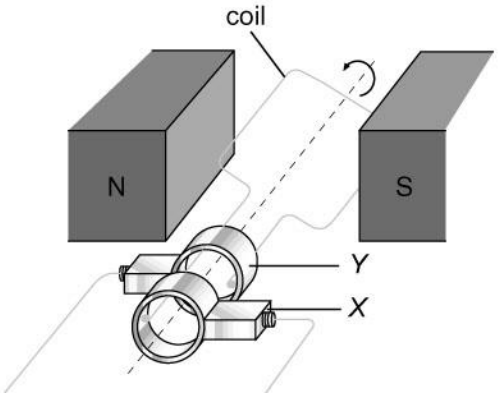
(a) Write down the directions of the magnetic forces acting on the sides (*AB*, *BC*, *CD* and *AD*) of the coil at the moment shown in the figure. (4 marks)

(b) Describe and explain briefly the motion of the coil as viewed by the observer. (5 marks)

-

4142037

★★ In the following figure, a rectangular coil is arranged in a magnetic field. When *X* and *Y* are connected to a battery, the coil rotates in anti-clockwise direction.



(a) To which terminal of the battery is *X* connected, positive or negative? (1 marks)

(b) The coil turns, oscillates a few times and then comes to rest lying along the vertical. Explain the motion of the coil. (4 marks)